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REMOVAL SITE EVALUATION K-65 SILOS
RADON TREATMENT SYSTEM

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**REMOVAL SITE EVALUATION
K-65 SILOS RADON TREATMENT SYSTEM**

**Fernald Environmental Management Project
(FEMP)
Fernald, Ohio**

January 1992

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1.0 INTRODUCTION

During the early 1950's, the former Feed Materials Production Center (FMPC), currently the Fernald Environmental Management Project (FEMP), processed high grade uranium/radium ore from the Belgian Congo. No chemical separation or purification was performed on the uranium/radium rich ore before it arrived at the FMPC for uranium recovery processing. Consequently, the residue from the process waste stream, termed K-65, contained significant amounts of radium. Due to the economic value of the radium, the residue was considered valuable and consequently was ensiled. As part of the purchase agreement, the African Metals Company retained ownership until the Department of Energy (DOE) assumed ownership of the residue in the early 1980's.

Four silos were constructed in 1951 and 1952 (Figure 1-1) for storing the residue; but only Silos 1 and 2 were utilized for the purpose of storing K-65 waste stream residue. Silo 3 was used to store metal oxides, and Silo 4 lies empty. From 1952 to 1958, these silos received residue in the form of a slurry. The waste stored in the silos includes the following:

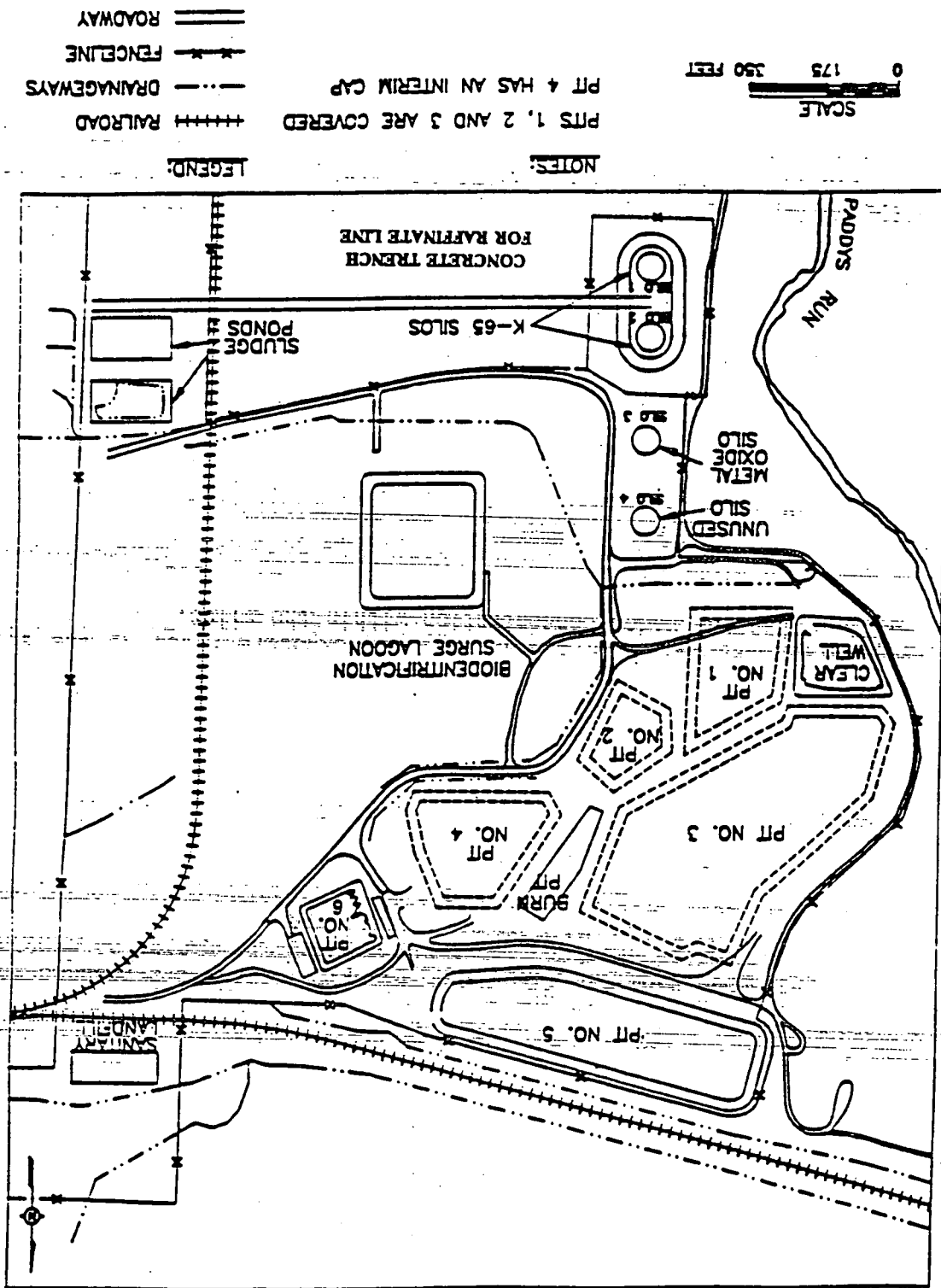
- o residue slurry from FMPC
- o the contents of 25,000 drums from the Mallinckrodt chemical plant in St. Louis, Missouri
- o the contents of 6,000 drums from a DOE storage site in Niagara Falls, New York

The silos contain a total of approximately 9600 tons of residue. The radioactive constituents of concern are uranium-238 and -234, radium-226 and thorium-230. The radium-bearing residue emits radon gas as well as radiation in the form of alpha, beta and gamma rays.

According to the Silo 1 and 2 Removal Action Work Plan, most of the radon being generated in the K-65 residues is contained within the silos. Before the placement of a bentonite seal over the residue within the silos in November 1991, approximately 12 curies of radon were released to the head-space of each silo per day. The concentration of radon in the head-space had been measured to be as high as 3×10^7 pCi/l. Using the previously measured concentration and the volume of the head-space of each silo, it had been calculated that approximately 33 curies of radon-222 exist in the head-space. Current measurements indicate that addition of the bentonite has reduced the head-space radon to approximately 0.5% of the previously measured values.

In 1963, exterior surface deterioration to the silos became apparent, and a repair program was initiated. In 1964, repairs were made to the shot-concrete coat, and an earthen embankment (berm) was constructed around Silos 1 and 2 to counterbalance the load from the silo contents. The berm also protected the walls from further weathering and acted as a radiation shield. Vents in the silos were sealed in 1979, and the berms were enlarged in 1983 to reduce erosion. In January 1986, 20-ft diameter, protective plywood covers for the silo domes were constructed as a result of a structural analysis done by Camargo Associates Limited in 1985. In 1987, a polyurethane foam coating was applied to the domes of the silos to further reduce weathering and to reduce radon gas emissions. In conjunction with this

FIGURE 1-1. FEMP SILO AREA MAP



effort, the Radon Treatment System (RTS) was developed and installed to temporarily reduce the radon emission from the silos (Bechtel, 1990).

The RTS was installed in November 1987 to reduce the radon inventory prior to the application of the polyurethane foam to the exposed domes of the K-65 silos. The RTS was designed and constructed as a temporary system to remove radon gas which is continuously generated within the K-65 Silos. The primary purpose of operating the RTS was to reduce the whole body radiation dose to personnel involved in dome-surface work in accordance with ALARA (as low as reasonably achievable) practices. A specific radiation dose rate objective for the RTS for the silo dome-surface was less than 100 mrem/hr. Reducing radon within the silos served two purposes:

- 1) the radiation levels on the silo domes were reduced for a several-day period which consequently reduced the radiation exposure to personnel working on the dome surfaces, and
- 2) the release of radon during any operation of the Interim Stabilization Project that required opening silo manways was minimized (WMC0 1990b).

Figure 1-2 illustrates the basic components of the RTS. The RTS was originally designed to be used on each K-65 Silo separately. This design assumed a system airflow of 1,000 ft³/min., an initial radon curie content in the air space above the residues of 37 Ci and a one-time, 10-volume turnover for each silo. It was estimated that at least 0.4 Ci of radon remained in the silos after treatment because of perpetual generation of radon. The controlling criterion for the RTS operation was based on gamma radiation exposure rates at the silo dome surface rather than the radon concentration within the silos.

The RTS consists of a temporary treatment building that contains:

- o 2 calcium sulfate drier (beds) canisters,
- o 8 charcoal adsorption (beds) canisters,
- o 2 fan units, and
- o a 32-inch-thick concrete block radiation shielding wall surrounding the treatment building.

The piping between the RTS shed and the K-65 silos consists of 12-inch diameter PVC pipe and 6-inch diameter flexible hose. The rigid pipe is supported throughout its length on the silo berm. This piping is equipped with butterfly-type valves to allow operation of the RTS in the silos independently or simultaneously.

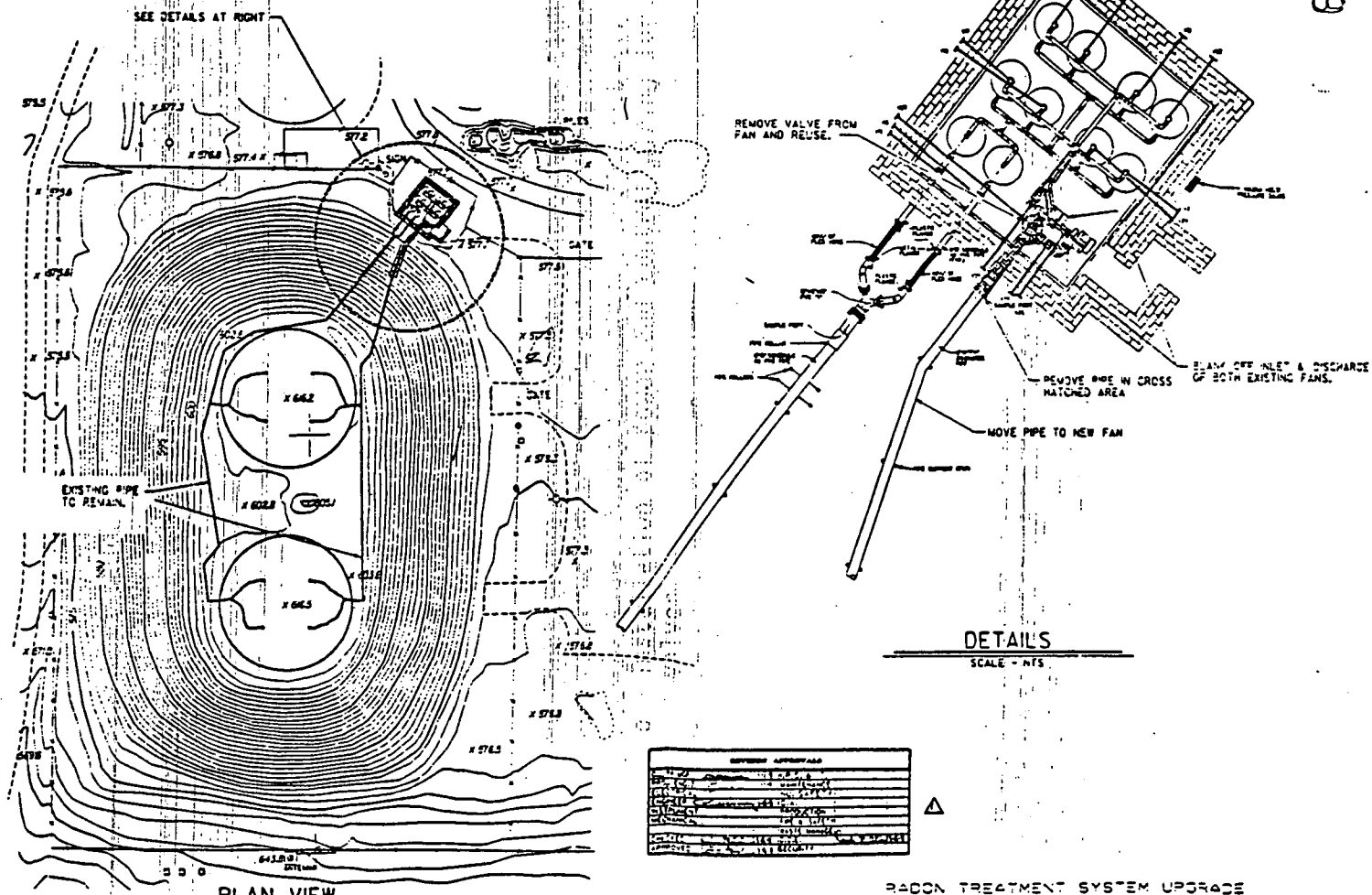
The drier and adsorption beds are valved in groups to provide operating flexibility. The desired operating configuration is selected via operation of manual valve actuation rods that extend through the concrete shielding wall. Access to the K-65 silos and RTS facility is restricted by a woven wire fence and locked gates.

The treatment system operated as a closed, recirculating system so that the radon component of the silo air volume is continuously adsorbed onto the charcoal beds. The basic operation of the system allows for the removal of contaminated air from the silos, transport to the treatment building, removal of moisture, adsorption of the radon, and return of the clean, dry air to the K-65 silos.

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FIGURE 1-2. RADON TREATMENT SYSTEM



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NOTES:
1. THIS DRAWING IS TO BE REVISED MANUALLY.

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WESTINGHOUSE MAT'L CO. OF OHIO
FERNALD, OHIO
FERNALD SITE OFFICE
U.S. DEPARTMENT OF ENERGY

K-65 SILOS
RADON TREATMENT SYSTEM IMPROVEMENTS
DEMOLITION PLAN
300-EE00-X-00124

Prior to installing the bentonite cover, it was estimated that an air volume changeout took place every 38 and 48 minutes for Silos 1 and 2 respectively, based on a system flowrate of 1000 ft³/min. On the average, operation of the RTS process reduced the surface radiation on the dome from 140 mR/hr to less than 60 mR/hr after approximately four hours of operation (WMCO, 1990c).

Although the RTS unit was designed to support a single task, the system has been utilized on several occasions since its initial use in 1987 to support the application of the polyurethane foam. In June of 1988, the RTS was operated to support the insertion of a CCTV camera to inspect the condition of the interior, exposed concrete. Later the system was operated on several occasions to support content sampling activities - first in June of 1989, and again in November and in December of that year.

In March 1990, a cracked tee pipe in the RTS unit was discovered and attributed to poor design and selection of materials. The piping failure was the result of degradation brought on by ultraviolet radiation, cold temperature embrittlement, thermal stress and severe stress that resulted from lateral movement against a rigid PVC tee. This incident prompted an investigation concerning further operation of the RTS unit. The investigative committee's recommendations were addressed and the system was next operated to support content sampling from October through December of 1990.

A decision was made that the system should be upgraded prior to any further operation. This upgrade included the following actions:

- o installation of a new higher static fan outside the RTS building
- o installation of new remote-controlled gas tight butterfly valves
- o construction of manhole extensions with permanent RTS ports provided for the eight peripheral manholes in the K-65 silos
- o installation of power and control wiring for the fan and PVC piping valves
- o pressure testing of the RTS unit to ensure piping integrity

On completion of the RTS upgrade, the system was operated to support three additional activities during the remainder of 1991 - completion of the content sampling during July and August, baseline surface mapping of the residue surfaces in September and October, and during the installation of the bentonite cover in Silos 1 and 2 in November. The application of the bentonite provided immediate protection from the effects of a tornado-induced or spontaneous dome failure as well as a significant reduction in the radon release from the silos (WMCO, 1990d).

Due to the nature of the original project, the design of the RTS does not meet the requirements for long term use under the provisions of DOE Order 6430.1A, General Design Criteria (WMCO 1990a). The inherent risks of operating such a facility are apparent. Furthermore, requirements for continuous and periodic radiation monitoring of the RTS, even when the system is not operating, subject personnel to additional radiation exposure. Additionally, the need to operate the RTS unit to reduce radon emissions has been eliminated as a result of the bentonite cover that is now in place.

This Removal Site Evaluation (RSE) has been completed by the DOE under authorities delegated by Executive Order 12580 under Section 104 of the Comprehensive Environmental Restoration Compensation and Liability Act (CERCLA) and is consistent with Section 300.410 of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP). This RSE addresses the RTS as a potential source for the exposure of the general population and the need for decommissioning and decontamination.

2.0 SOURCE TERM

Potential sources of contamination considered in this RSE are the plateout of radioactive material inside the piping and the lead-210 trapped in the desiccant and the charcoal filter canisters of the treatment system. The probability and consequences of a release from these sources are discussed in Section 3.

2.1 Radon in Silo Head-Space

Prior to installing the bentonite cover, the radiation activity from radon in the head-space had been measured to be approximately 33 Ci in each silo (WCMCO 1990e). Approximately 12 Ci of radon per day were released to the head-space of the silos. The Silos 1 and 2 Removal Action has reduced the levels to about 0.5% of the prior value. Therefore, this source was not considered in this RSE.

2.2 Radioactive Material Plateout On Inside Piping

During the investigation of the cracked piping, radon daughter product plateout inside the piping was discovered. Consequently, personnel became contaminated from what was considered a radiologically "cold" system. Considerable radiation was measured at the crack in the piping. Radiological surveys indicated significant contamination levels within the piping.

2.3 Pb-210 in Charcoal Canisters

The radon treatment system was operated for only one silo at a time. During operation, the radon gas was trapped primarily in the charcoal canisters and to a small degree in the desiccant canisters located in the RTS block building. Assuming equilibrium between radon and all daughters and a charcoal removal efficiency of 100%, there should be approximately 9.5 Ci Pb-210 trapped in the canisters after the RTS has been operated seventy-five times. These calculations are included as Appendix A (WEMCO 1991). Due to the relatively short half-lives of the daughter product, no other isotopes were considered.

3.0 EVALUATION OF THE MAGNITUDE OF THE POTENTIAL THREAT

The primary threats are the releases and the potential migration of the radon daughter product Pb-210 and other radioactive material both on-site and off-site. Although several scenarios could potentially result in a release of radioactivity to the environment from the RTS unit, the two considered the highest magnitude of threat are considered in this document. These scenarios are a failure of the plastic piping at the RTS and a natural disaster occurring at the RTS block

building. Figure 3-1 summarizes subjectively the probability of occurrence and risk to human health and the environment of these events.

A piping failure has already been documented, and the potential for another failure is significant. However, contamination to personnel from plated-out radioactive material in the failed piping is moderate to low due to implemented safety procedures and radioactive half-lives of the daughter products. The probability of a natural disaster - such as a tornado or violent winds, destroying the block house and releasing radon daughter plateout in the dehumidifier canisters and the radon daughter Pb-210 in the charcoal canister - is much lower. The risk from the radon daughter Pb-210 is moderate while the risk from the other daughters is low due to their faster decay rates. These events are discussed in the following sections.

EVALUATION OF RISK FROM POTENTIAL EVENTS FIGURE 3-1	
EVENT:	Pipe Break
RTS MODE:	Non-operational
Probability:	High
Risk:	Low
EVENT:	Natural Disaster
RTS MODE:	Non-operational
Probability:	Low
Risk:	Moderate

3.1 Piping Failure

The PVC piping used on the RTS has already failed. A crack in a tee occurred between December 13, 1989 and March 16, 1990. This event ultimately resulted in contamination of personnel and prompted a formal investigation (WMCO 1990a).

An independent engineering analysis (PARSONS, 1990) of this event was conducted. On June 11, 1990, the results of this investigation were issued. A copy of this report is included as Appendix B. The piping failure was attributed to poor design and selection of materials. Degradation of the PVC pipe and fittings resulting from ultraviolet radiation and cold temperatures had caused embrittlement which led to the failure. Poor design allowed lateral movement of the piping and concentrated the stress at the rigid tee. Recommendations were given for the continued use of the RTS unit. Based on the condition of the pipe and the poor design, additional failures could not be discounted; but the possibility of such failure has now been reduced due to implemented safety procedures and upgrades done on the system in the summer of 1991.

The worst case piping accident associated with the RTS is a complete shear. The risk of this accident is solely based upon the consequences (assumed probability of occurrence is certainty), since:

- (a) a fracture of the RTS piping has already occurred and
- (b) the RTS is a temporary facility that does not conform to the DOE design requirements (DOE Order 6430.1A)(WMCO 1990c).

Therefore, the worst case risk analysis of the RTS is solely an analysis of the consequences of occurrence.

3.2 Natural Disaster

In this scenario, a severe weather event, such as a tornado, would result in the release of the Pb-210 and other daughter products inventory contained in the RTS building. While the risk of this event is moderate, the probability is low due to the physical containment of the Pb-210 and the radioactive half-lives of the other daughter products. The carbon canisters are contained in a metal building surrounded by 32 inches of stacked, solid concrete stretcher blocks. If these structures were destroyed, the canisters would still contain the lead. If the canisters were also destroyed, the carbon granules are too large to be widely dispersed through the atmosphere. Further, the lead, as a solid, is contained within the pores of the carbon and would not be available for respiratory uptake. The probability of such an event occurring within a square mile in the vicinity of FEMP is estimated at 1.2×10^{-4} per year (Janke, et al, 1990).

3.3 Potential for Exposure

Before the completion of the bentonite cover on the residues, the pipe-break scenario would have resulted in exposures to the public between 47 and 98 mrem depending on atmospheric stability class (WMCO 1990c). The radiation standard for the whole body dose to an off-site receptor is 25 mrem/year (40 CFR 192, and 40 CFR 190). Thus, the standard would have been exceeded for this scenario.

Currently, there is no need for further operation of the RTS unit, and it remains in stand-by condition with its radon tight isolation valves in the closed position. A piping failure at the current time would not exceed the radiation standard for three reasons. First, the head-space radon content has been reduced to approximately 0.5% of the value measured prior to the bentonite addition. Second, the radon tight isolation valves, which were installed as part of the RTS upgrade, prevent head-space radon from migrating into the piping system. And third, the scenario that was analyzed was based on a pipe-break during RTS operation; but no further operation is contemplated.

With respect to plate-out of radionuclides on the inside of the piping, recent measurements of the dose through the pipe gave readings of less than 0.5 mr/hr, which is essentially below the limit of detection for the instrument used to make the measurements. Although the plated radionuclides will continue to decay with time, the piping will continue to be classified as contaminated, but the potential health risk will become negligible with time and will approach zero as the Pb-210 continues to decay.

4.0 ASSESSMENT ON THE NEED FOR A REMOVAL ACTION

Consistent with Section 40 CFR 300.410 of the NCP, the DOE shall determine the appropriateness of a removal action. Eight factors to be considered in this determination are listed in 40 CFR 300.415 (b)(2). The following apply specifically to the Radon Treatment System.

40 CFR 300.415 (b)(2)(i)

Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants.

40 CFR 300.415 (b)(2)(iii)

High level of hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers, that may pose a threat of release.

40 CFR 300.415 (b)(2)(v)

Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.

40 CFR 300.415 (b)(2)(viii)

Other situations or factors that may pose threats to public health or welfare or the environment.

5.0 APPROPRIATENESS OF A RESPONSE

If it is determined that a response action is appropriate due to the potential for contaminants to be released and migrate from an incident at the RTS unit, a removal action may be required to address the existing situation.

If a planning period of less than six months exists prior to initiation of a response action, DOE will issue an Action Memorandum. The Action Memorandum will describe the selected response and provide supporting documentation for the decision.

If it is determined that there is a planning period greater than six months before a response is initiated, DOE will issue an Engineering Evaluation/Cost Analysis (EE/CA) Approval memorandum. This memorandum is to be used to document the threat of public health and the environment and to evaluate viable alternative response actions. It will also serve as a decision document to be included in the Administrative Record. The FEMP site is currently on the National Priorities List and is in the RI/FS process.

6.0 REFERENCES

Bechtel National Inc., 1990. Engineering Evaluation/Cost Analysis (EE/CA) K-65 Silos Removal Action.

Camargo Associates, Ltd., 1986, *K-65 Silos Study and Evaluation for the Feed Materials Production Center, Volume 1.*

Janke, R., Janke, R. and Ijaz, Talaat, 1990. *A Probabilistic Risk Assessment for the K-65 Silos at the FMPC.*

R. M. PARSONS Co., 1990. *Failure of the PVC Piping, K-65 Silos Ventilation/Treatment.*

Westinghouse Materials Company of Ohio, 1988. Letter to James A. Reafsnyder. Subject, *Completion Report for the Exterior Foam Application/Radon Treatment System Operations of the K-65 Interim Stabilization Project.*

Westinghouse Materials Company of Ohio, April 16, 1990(a). Unusual Occurrence Report, *Investigation of the Loss of Integrity of the Radon Treatment System Piping.*

Westinghouse Materials Company of Ohio, March 30, 1990(b). Request For Safety Assessment, Radon Treatment Systems Test.

Westinghouse Materials Company of Ohio, 1990 (c). Safety Assessment for Sampling and Analysis of the Materials in the K-65 Silos (1&2). WMC0:IRS&T(NS):90-1028

Westinghouse Materials Company of Ohio, 1990(d). *Silos 1 and 2 Removal Action Work Plan.*

Westinghouse Materials Company of Ohio, July 16, 1990. Letter to W.H. Britton. Subject, *Action Complete: K-65 Investigative Committee Recommendation # 1.* WMC0:R:AEC:90-0025

Westinghouse Environmental Management Company, October 29, 1991. Letter to D. A. Nixon. Subject, *Basis for Pb-210 Estimate in RTS System.* WEMCO:IRS&T(RA&I):91-337.

APPENDIX A



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From: G. J. Calhoun
Date: October 29, 1991
Subject: BASIS FOR Pb-210 ESTIMATE IN RTS SYSTEM

WEMCO:IRS&T(RA&I):91-337

To : D. A. Nixon

REFERENCE: 1. CYCLIC OPERATION OF THE RADON TREATMENT SYSTEM TO
REDUCE K-65 EXPOSURES, WMC0:DE:89-057, December 1989.

The following is the basis for the estimate of Pb-210 contained in the Radon Treatment System charcoal canisters. The original assumption of 50 Ci of Rn-222 in the headspace of the silos was based on reference 1.

Estimate of Pb-210 Activity in RTS Charcoal Canisters

1. Calculations suggest that there is approximately 50 Ci of Rn-222 in equilibrium with its daughters in the headspace of each K-65 silo prior to the operation of the Radon Treatment System.
2. Assuming there is 100% equilibrium the total activity is as follows:
 - 50 Ci Rn-222
 - 50 Ci Po-218
 - 50 Ci Pb-214
 - 50 Ci Bi-214
 - 50 Ci Po-214
3. Given the longer relative half life of Pb-210 only .05% of this activity has decayed to Pb-210. This means that approximately 125 mCi Pb-210 is deposited in the RTS each time it is operated. (This is taking the conservative approach and assuming it is all removed.)
4. Assuming the activity is equally distributed in the eight charcoal canisters and the system will have been operated 75 times there should be approximately 1.2 Ci Pb-210 per canister.

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Another Possible Scenario

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5. The radon daughters existing at the time of operation are trapped in the desiccant while the radon gas is trapped in the charcoal.
6. This would result in approximately 3.75 Ci Pb-210/desiccant canister and .25 Ci Pb-210/charcoal canister.

Conclusion

7. There should be approximately 9.5 Ci Pb-210 contained within the RTS system after it has been operated 75 times.

Note: To be conservative it could be assumed that activities of Bi-210 and Po-210 have ingrown to become equal to that of Pb-210.

If you have any questions feel free to contact me at x6233.


Grady Calhoun

c W. G. Tope

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APPENDIX B

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R. M. PARSONS (818) 440-2630

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Worldwide Engineers/Constructors

R/P

100 WEST WALNUT STREET
PASADENA, CALIFORNIA 91106
(818) 440-2630
Telex: WME 676-336

July 2, 1990

Westinghouse Materials Co. of Ohio
P. O. Box 398704
Cincinnati, Ohio 45239-8704
Attention: P. Beirne-FMPC/Fernald

SUBJECT: Failure of PVC Piping, K-65 Silos Ventilation/Treatment.
Visit to Fernald Facility for Failure Analysis.

The writer visited the Feed Materials Production Center (FMPC) in Fernald, Ohio on June 11, 1990, to attempt to determine the cause of failure of a 6" PVC tee entering the radon treatment, ventilation building for the K-65 Silos. While at FMPC, the writer visited with Messrs. P. Beirne and D. Gilbert.

With Mr. Gilbert, the writer reviewed the installation area (by remote camera) and inspected the failed 6" PVC tee and a section of the 12" PVC pipe which had been removed from the site at the same time the tee was removed.

The following notes and observations were made:

1. PVC pipe is not suitable for outdoor installation and service as it is sensitive to ultra violet (UV) radiation (sunlight).
2. There was visible degradation of the PVC pipe and adhesive on areas exposed to UV radiation.
3. There were two (2) separate sections of 12" PVC pipe (each approximately 100' in length) which encountered an approximate 30' drop from the top of the silo embankment to the fence area of the ventilation, treatment building. These sections of pipe appeared to be randomly supported approximately 6" to 12" above the ground by concrete block. Restraint poles to prevent lateral movement were bent and offered very little restraint if any, to lateral movement of the pipe due to wind.
4. Inside the fence area, one length of pipe was reduced from 12" to 6" in two increments just prior to entering the building. The second length was also reduced from 12" to 6" in two increments and then connected to a 6" tee. The tee was buried (approximately 50% of the longitudinal sections) in the block wall of the building. See Figure 1.
5. It is anticipated that a 100' length of PVC pipe would expand/contract a total of 6" due to temperature variations encountered in the area.
6. Any stress generated by expansion/contraction and lateral movement of the 100' length of pipe would be concentrated at the 6" tee-which being buried in the wall-would be very rigid. The reduced area (12" to 6") would also be a somewhat rigid section, and would transmit stress to the tee.

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7. The set-up was originally intended to be temporary, and has been in service for approximately 3 1/2 years.
8. It is suspected that the crack was initiated during February 1990 at a time when the temperature dropped from the mid-60's to around 9°F, over a two-day time frame. At 9°F, the PVC would be brittle.
9. Both UV degradation and low temperature will cause PVC to become brittle. Radiation will also embrittle PVC, however in this case there appears to be little radiation damage.
10. The failure occurred circumferentially around a leg of the tee, at the point where a 6" length of pipe was fitted. See Figure 2.
11. Visual examination of the fracture face indicated a progressive failure around approximately 50% of the circumference (subjected to UV), with an instantaneous or catastrophic failure around the remainder of the circumference (inside the wall and not subject to UV).
12. Visual examination of several joints showed degradation of the adhesive exposed to UV, and possible poor assembly technique during installation.

CONCLUSION

It is the writer's opinion that failure can be attributed to poor design and selection of materials. Degradation due to ultraviolet radiation, and cold temperatures would result in embrittlement of the PVC pipe and fittings. Poor design allowed for lateral movement of the piping and concentrated stress at a very rigid tee-made rigid by a stiff area of reduction from 12" to 6" and being partially buried in the wall of a building. The failure appeared to initiate in an area subjected to UV, proceeded approximately 50% of the circumference over some time frame, and then catastrophically over the remainder of the circumference.

RECOMMENDATIONS

A. Completion of the Sampling Program

WMCO indicated that to complete the air sampling program of the K-65 Silos, a key element in the RI/FS process, they would like to repair the failure and operate the system intermittently for less than 8 hours per day from late July through early December for approximately 70 total operating hours.

Recommendation

Assurance that added failures will not occur cannot be given due to the condition of the pipe; however should the sampling operation proceed, then the following actions are recommended.

1. A detailed inspection be made of all the existing joints to determine if any show evidence of cracks.
2. All necessary repairs be made with an approved and tried technique. Bristol Pipe, manufacturers of the existing pipe recommended contact with the Plastic Pipe Institute, N.J. for technical assistance.
3. The piping be supported above grade at 10' to 12' intervals.

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4. The piping be restrained to 10' to 12' intervals to prevent lateral movement due to wind loading.
5. The pipe be leaked tested, and any leaking joints be repaired, again using an approved and tried technique.
6. Where possible, expansion joints be provided to compensate for expansion/contraction due to temperature variation.
7. If possible, paint the pipe with a water base paint to minimize future UV degradations.
8. The entire system be periodically inspected (on a frequent basis) for leakage and cracks.

B. Continued Operation of the System

~~If the system is to be used continuously for radon absorption then the piping system should be redesigned and replaced for the following recommendations:~~

1. The PVC pipe be replaced with either fiber reinforced plastic (FRP) or high-density polyethylene (with min. of 2% carbon black) pipe, both of which can be procured with minimum sensitivity to UV radiation.
2. The pipe should be supported above grade every ten (10) to twelve (12) feet.
3. The pipe should be restrained every ten (10) to twelve (12) feet to prevent lateral movement due to wind loading.
4. Expansion joints or expansion loops be provided to allow for expansion/contraction due to temperature variation.
5. Prior to installation, personnel involved be given some training by suppliers/manufacturers of the pipe in the proper installation techniques.
6. Design of the system be reviewed by an individual familiar with and competent in the design of facilities involving plastic pipe.
7. Leak test the system to assure compliance with operational factors and criteria of the Radiological Safety Department at Fernald.

C. To Determine Further Data on the Pipe Fracture

The writer contacted Bristolpipe, manufacturers of the existing PVC pipe. Unfortunately they were of little help in trying to determine the potential extent of UV degradation, or possible repair procedures (if needed) on the existing pipe. They did recommend the writer contact the Plastic Pipe Institute, located in New Jersey, for possible assistance.

The writer talked with a Mr. Norm Bryan of PPI who was very helpful. Mr. Bryan indicated there are tests which can be performed to determine the extent of degradation by UV radiation. According to Mr. Bryan, microscopic, tensile and impact tests could be made and compared to the original (guaranteed) values, and possibly determine the potential remaining life of the system. The closest laboratory he knew of was L. J. Broutman & Associates in Chicago, Illinois. He recommended contacting a Mr. Don Duvall at the laboratory for additional information.

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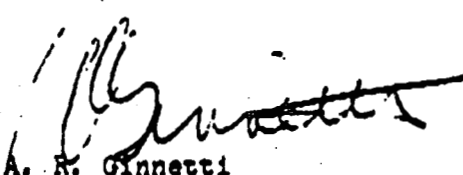
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Mr. Bryan indicated that had the original PVC pipe be painted with a water base paint, UV degradation would have been minimal. He also indicated Mr. Duvall might be of assistance in suggesting possible repair of degraded areas of adhesive, or where repair might be necessary for other reasons.

It is suggested that Mr. Duvall be contacted, and a sample of the PVC pipe be sent for evaluation.

If there are any questions regarding this investigation or the recommendations please call.


A. R. Ginnetti
Senior Member Technical Staff
Material Applications Group
The Ralph M. Parsons Company

References:

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